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(12) UK Patent Application (19) GB (11) 2 253 878 (13)

(43) Date of A publication 23.09.1992

(21) Application No 9125802.8

(22) Date of filing 06.12.1991

(30) Priority data

(31) 9102485

(32) 05.02.1991

(33) GB

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(51) INT CL⁴

E04F 21/18 21/20

(52) UK CL (Edition K)

E1S SAB

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(58) Field of search

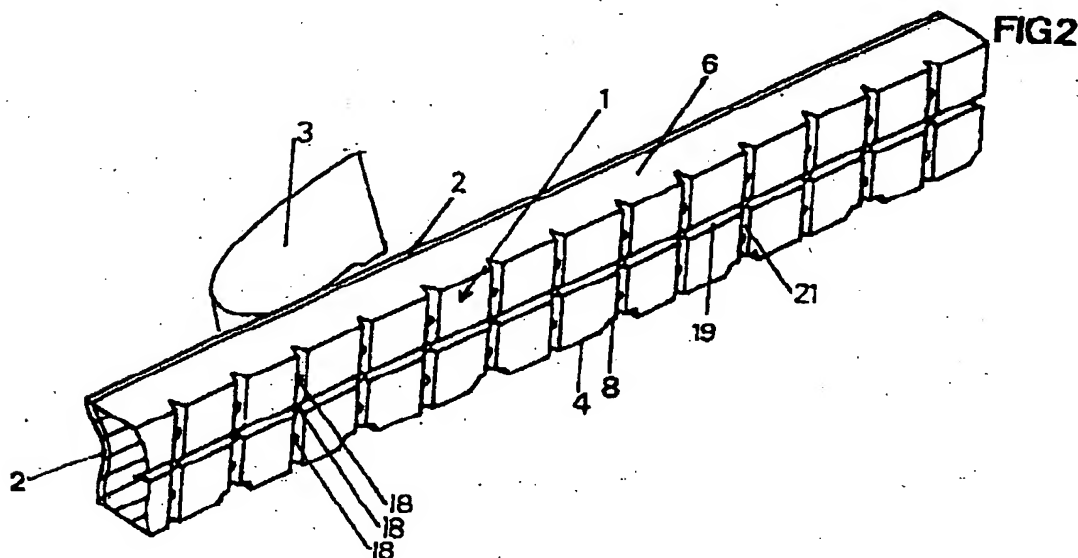
UK CL (Edition K) E1D OPG, E1S SAB SAD

INT CL⁴ E04F, E04G

On-line database : WPI.

(54) Tile support, set square, guide and spacing strip

(57) A device for use in tiling floors or walls comprising a strip (1) which is substantially rigid in a transverse direction for supporting a course of tiles and has a series of "V" shaped grooves (21) in at least one surface so that the strip (1) is sufficiently flexible in a direction perpendicular to the plane of the strip (1) to allow the strip to be shaped against an uneven or curved base surface. The strip may also be provided with a series of outwardly projecting lugs along one edge which facilitate the positioning of tiles (13) without integral spacers. The strip may have a self-adhesive backing.



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TILE SUPPORT, SET SQUARE,
GUIDE AND SPACING STRIP

The application of tiles made in a variety of different materials to walls, other surfaces requiring this treatment, and floors, is a well known task to those skilled in the art. Tiles are attached to surfaces by means of an adhesive applied to the surface to be tiled. For the majority of applications tiles are adhered to surfaces set square to one another and to floors, walls, furniture and other objects of a fixed nature.

Walls, floors, furniture and other fitments are for most purposes set square horizontally and vertically to one another. However for the purposes of tiling upon surfaces this cannot be assumed in the majority of situations.

Consequently it is not possible for an individual tiling a surface to begin from the position where the wall meets the floor, or adjacent to a vertical wall or object. To avoid this problem the method known to those skilled in the art is to adhere the second course of tiles positioned horizontally by means of a spirit level, one tiles depth above the floor or skirting. A wooden batten is placed level with the bottom edge of the second course of tiles to support them while the tiling adhesive dries, so that they will not slide downwards. A batten is also attached to the wall vertically to obtain a vertical positioning guide for tiles and is set square to the horizontal batten.

Tiles are positioned on the wall resting upon the batten with tile spacers placed between them vertically and horizontally including the space between the tile and the batten upon which it rests. This achieves a space between all edges of each tile, which are subsequently filled with grout a practice known to those skilled in the art. However some tiles have spacing lugs or bevels on their edges as an integral part of their form. When these tiles are placed adjacent to one another, the desired space surrounding each tile as explained previously is achieved automatically. Tile spacers are therefore unnecessary with these types of tile.

When the tiles are fixed securely in position, the battens are removed and the irregular spaces below the second course of tiles are filled with tiles cut to fit the spaces remaining. The remaining vertical spaces which are less than one tiles depth are filled with tiles cut to fit, when the vertical battens have been removed.

Attaching battens to walls and other surfaces is time consuming and problematical, requiring tools which are otherwise superfluous to the practice of tiling.

Wooden battens can be fixed in position by means of masonry nails. These can damage the wall if the surface and substrate are too hard or too fragile. In some cases the surface and substrate can be so hard that the nails bend and cannot be used. If one is tiling over existing tiles mortar nails will not penetrate this surface. Even if mortar nails can be used it is difficult to maintain the batten in a level position while hammering in the mortar nails. The nail can veer off position due to the varying materials in the surface and substrate, damage to the wall is likely.

Another approach would be to drill holes into the wall, insert wall plugs

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into which screws passing through previously drilled holes in the batten can be inserted and tightened into the wall plugs. This procedure is essential when applying battens to previously tiled surfaces.

This process requires additional equipment, a wood bit to drill the hole in the wooden batten, a masonry bit to make a hole in the wall with a hammer drill or alternatively a jumper to make the aperture. Under these circumstances accuracy in positioning and the size of the aperture depends as before upon the condition of the wall surface and substrate. Damage to the wall can occur, the drill bit or jumper producing an aperture which is inaccurate or too large for the plug to be inserted.

When tiling onto plasterboard, thin sections of wall panel or other surface, the use of nails to attach battens, especially to cavity walls is impractical and likely to cause damage. If wall plugs and screws are employed to attach battens, then cavity wall plugs must be used, these are also superfluous to other tiling requirements.

As a material cost wooden battens are both expensive and waste a valuable natural resource. A high proportion of wood is bowed in its length, this cannot be used as it reduces accuracy when tiling. Varying depths of wood to support different thickness of tile are also required in some circumstances, where the depth of the batten is too narrow to be fixed by nails or plugged screws, when thin battens are used in restricted spaces.

If tiling spacers are required these must be placed upon the top edge of the batten for the second course of tiles to rest upon, this technique demands that the batten is thick enough to enable the spacers to rest upon the top edge, which for this purpose is thicker than would otherwise be necessary to support the tiles alone.

In addition wooden battens cannot follow curved wall surfaces, which require tiling be they convex or concave or follow a circumference.

When floors require tiling use is made of wooden battens to set square and position tiles by means known to those skilled in the art. The same fixing difficulties occur with the variety of surface and substrates as described previously, when wooden battens are attached to floors made of cement, stone, or similarly hard, unstable or friable material. The problems and techniques for attaching wooden battens to floors is the same as described previously for walls.

According to the present invention there is provided a strip for supporting, squaring, guiding and spacing wall and floor tiles on flat, curved and uneven surfaces, the aforementioned strip is self adhesive or can be affixed by means of nails or pins of a suitable type to surfaces which are to be tiled. The strip can be fabricated in greyboard, fibreboard, cardboard, plastics material or any other suitable material either natural,

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synthetic or a combination of both. It can be produced more cheaply than wooden battens and be fabricated using recycled materials.

The self adhesive coating is applied to the rear face of the strip, which is covered with a removable protective backing. The self adhesive properties of the strip make it far quicker and easier to use than conventional wooden battens. The ability to adhere the strip to surfaces also enables it to be affixed in restricted spaces where a hammer could not be swung in order to nail a wooden batten, or a drill and screw driver used to screw and plug a wooden batten to a surface. Two different surfaces are provided on which the tiles being fixed to a wall, may be supported. One support surface provided, is flat and is for use with tiles which have means for spacing themselves as part of their fabrication. The other surface is raised at intervals to provide the spacing means for tiles which have no spacing system as part of their fabrication. These raised support surfaces provide the correct spacing between the first and second horizontal courses of tiles.

As with wall tiles, floor tiles with or without means for spacing may be applied using whichever surface is appropriate as explained previously, the edges of the floor tiles being offered to either surface, the adhesive backing making contact with the horizontal surface as opposed to the vertical surface used when tiling walls.

The raised support surfaces can be produced to any proportion, length, depth, frequency and configuration as can the lower surfaces interspersed between them. The top rear edge of the lower surfaces are used to align the support strip to a mark made horizontally level on the wall surface.

The front face of the strip has vertical incisions made at regular intervals from one support surface to the other and into the front face of the strip. The incisions are in the form of a "V" shaped section or die stamped square sided section, which enables the strip to flex inwards and outwards, thereby giving the strip greater flexibility necessary on curved and uneven surfaces where more rigid grades of materials are used. The 'V' section is widest on the front surface thereof. These incisions also provide points whereby the strip can be cut to a convenient length and can be manufactured to any depth, width or frequency depending upon the degree of flexibility required.

A version of the strip which provides even greater flexibility is achieved by making 'V' shaped or square sided die stamped incisions vertically into the front and back surfaces, thereby enabling the strip to flex more than if the incisions were placed on one surface alone. The incisions made into the front face of the strip are positioned so that they are not opposite the incisions made into the back of the strip thereby retaining greater strength. Placing the incisions directly opposite would serve to weaken the strip.

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The 'V' shaped or square sided incisions can be used offering varying degrees of flexibility, the wider and deeper the incisions the greater the flexibility achieved. Strips with or without incisions are easy to cut to length with a knife, thereby dispensing with the need for a wood saw, which is necessary when cutting wooden battens.

The strip can also be used in very short lengths for supporting tiles where wooden battens could not be or would not be used, or would be very difficult to use since fixing becomes a problem with such short lengths. The strip can be used to support the smallest width of tile which can be cut by a tile cutter. This is not possible with a wooden batten.

Situated at and positioned horizontally across the front face of the strip is a 'V' shaped incision made part way into the front face of the strip, which enables the strip to be cut easily along its horizontal axis, thereby reducing its depth so that it may be used where there is restricted space. The 'V' shaped incision is widest at the front surface. More than one horizontal incision may be made in the same way as described previously so that the strip can be used in even smaller spaces. Tile cutters are restricted in the minimum depths of tile they are able to cut. The depth of the strip can be fabricated to fit into such restricted spaces and support tiles, where it would be difficult or impossible to nail or screw traditional wooden battens. Tilers therefore, are not required as with wooden battens to assess the need for different depths of wood as the strip can be used in the majority of situations. Vertical and horizontal incisions can be produced to any width, depth or frequency required. Alternatively die stamped incisions to any width, depth or frequency which are square sided can be used instead of 'V' incisions.

At intervals along the horizontal and vertical 'V' shaped or square sided incisions, apertures pass from the front face through to the back face. Nails, pins or screws can be inserted through these to enable the strip to be attached to a wall or floor surface, if this is preferred to the use of the adhesive backing.

The strips reduced weight and thickness compared to wooden battens means that if it is to be nailed or screwed onto a wall, floor or any other surface, the nails or screws required are much shorter and smaller than would be necessary with wooden battens. This reduces the damage potential to walls and reduces the cost of fixings.

The strips being lighter and smaller in section than the equivalent wooden battens, means that they are easier to transport and can be offered in convenient lengths, for example 2 foot lengths. The equivalent wooden battens would have greater volume and cost extra to have them cut to convenient lengths for transportation purposes.

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The strip can be fabricated in its basic form as an adhesive strip without the raised support surfaces, horizontal incisions of either type, vertical incisions of either type and apertures for nails, pins or screws. Alternatively all of the aforementioned features or any combination thereof can be fabricated. Illustrations for these versions of the strip are shown in figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16.

There is also provided a version of the "self adhesive tile support strip" which is fabricated in sections spaced as required and manufactured in greyboard, fibreboard, cardboard or plastics material or any other suitable material natural or synthetic or a combination of both. These sections are adhered to a flexible backing strip which can be made in any of the previously mentioned materials or other suitable material natural, synthetic or a combination of both.

The flexible backing strip is coated with adhesive protected by a removable backing strip. As with the other versions of the strip it is applied in the same way to surfaces which are to be tiled.

The spaces between the sections allow the strip to flex in conjunction with the flexible backing strip and the support sections can be spaced on the flexible backing strip to achieve the desired level of flexibility. The wider the spaces between the sections the greater the flexibility. The support sections of the strip are not joined together and form a strip because they are adhered to the flexible backing strip.

This method of achieving flexibility makes the use of 'V' shaped or squar sided incisions unnecessary. The illustrations for this version of the strip are shown in Figures 17 and 18.

All versions of the "Self adhesive tile support strip" can be waterproofed by additives mixed with the pulp materials used in the greyboard, fibreboard or cardboard. These materials can be laminated or surface coated to protect them from water. However the strips do not normally come into contact with water or damp conditions. Tiling should only be undertaken on completely dry surfaces.

Various embodiments of the invention will now be described by way of an example with reference to the accompanying drawings in which:-

Figure 1 shows an end elevation of the self adhesive support strip which is attached to the wall surface by means of an adhesive backing strip or can be attached to the wall by means of nails or pins inserted through apertures situated through the front surface of the support strip. Upon

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the support strip is illustrated a tile adhered to the wall surface by means of tiling adhesive.

Note: The cross section of the strip is not cross hatched, all other elements in Figure 1 are cross hatched, thereby differentiating between the elements shown.

Figure 2 shows in isometric view the strip with flat horizontal support surface uppermost and the "V" shaped vertical and horizontal incisions made in the front face. Also shown is the adhesive coating applied to the strip with the protective backing being pulled away from it.

Figure 3 shows in isometric view, the strip with raised spacing supports uppermost and the "V" shaped vertical incisions made into the front face. Also shown is the "V" shaped horizontal incision made into the front face.

Figure 4 shows a front elevation of the support strip with raised spacing supports uppermost with lower alignment sections interspersed between them. The flat support surface which can be used instead of the raised support surface is shown situated under the strip. Also shown are "V" shaped incisions made into the front surface of the strip. Also shown are the apertures made through the strip from the front face through to the back face.

Figure 5 shows a plan view of the strip with adhesive backing and a cross section of the "V" shaped vertical incisions which are made into the front face of the strip.

Figure 6 shows a plan view of the strip with adhesive backing and raised support surfaces. "V" shaped vertical incisions are shown in cross section made into the front face of the strip.

Figure 7 illustrates in plan view the way in which the "V" shaped incisions open and close, allowing the strip to flex and thereby follow an irregular wall or floor surface.

Figure 8 illustrates in plan view, the strip fixed to a wall which is convex in shape, the "V" shaped incisions open up to enable the strip to flex and thereby follow the shape of the wall.

Figure 9 illustrates in plan view, the strip fixed to a wall which is concave in shape, the "V" shaped incisions close up to enable the strip to flex and thereby follow the shape of the wall.

Figure 10 illustrates in plan view, the strip fixed to a wall surface with another strip adhered to it, thereby providing a wider support surface.

Figure 11 illustrates in elevation, the strip fixed to a floor surface with the option of another strip, shown adhered to it, thereby providing a deeper squaring and positioning guide, for use with thicker tiles.

Figure 12 illustrates the way in which the tile support, set square, spacing and guide strip is used horizontally and vertically when tiling a wall surface. The example shows the strip being used with the raised support edge uppermost. If required the flat surface on the opposite edge may be used as explained earlier.

Figure 13 illustrates the way in which the tile support, set square, guide and spacing strip is used to tile a floor surface.

Figure 14 shows in isometric view the basic version of the strip with an adhesive backing strip and removable protective backing strip without any other features incorporated. Both support surfaces are flat.

Figure 15 shows in plan view the shape of vertical incisions which are die stamped and are square sided as opposed to 'V' shaped vertical incisions, illustrated previously.

Figure 16 shows in plan view the die stamped vertical incisions made into the front and rear face of the strip, they are positioned so that the incisions on the front of the strip are not opposite the incisions on the back, thereby maintaining the strength of the strip. This version provides maximum flexibility. 'V' shaped vertical incisions can be used instead of square sided incisions (not illustrated).

Figure 17 illustrates in isometric view another method of strip construction. This version is applied in sections, here shown with raised support surface uppermost and flat support surface below. The sections are adhered to a flexible backing strip which has an adhesive backing applied to it. A removable protective backing strip protects the adhesive as with other versions of the strip. All additional features previously described for other versions of the strip or any combination of these can be incorporated in this version. However the vertical spaces between sections are employed to effect flexibility in the strip instead of 'V' shaped or square sided vertical incisions.

Figure 18 shows a plan view of the strip illustrating the spaces between support sections which are attached to the flexible backing strip which in turn is coated with an adhesive layer protected by a removable backing strip. The strip is shown adhered to an irregular wall surface with the flat support surface uppermost.

Referring to the drawings the strip comprises a main body 1 with an adhesive layer 2 covering the back of the strip. The 'V' shaped vertical incisions 21 on the front face of the strip, provide the strip with its horizontal and vertical flexibility, when the strip is used either vertically or horizontally. These incisions provide convenient points at which the strip may be cut to length. A thin protective coating 3 is then removed revealing the adhesive 2. Figure 2.

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If tiles with spacing lugs or bevels as part of their integral form are to be affixed, the alternative support surface 6 figure 2 which is flat, is used instead of the raised support surface 4 figure 3. This is placed uppermost and the top rear edge is aligned horizontally level with a line 10 Figure 12 which has been drawn with a spirit level one tiles depth up from the floor 11 illustrated in Figure 12. The use of the flat surface 6 is not illustrated in Figure 12: however if the surface 6 is used it aligns to the lines defined by the same reference numerals as those for surface 4.

If tiles without spacing lugs or bevels as part of their integral form are used, the support strip 1 with raised support surfaces 4 is used, Figure 12. The top rear edges of the recessed sections 8 are used to align the tile support level with the line 10, Figure 12 previously mentioned. The strip 1 is then pushed against the wall so that the adhesive layer 2 makes contact and fixes the strip to the wall surface 14. Nails, pins or screws can be used to attach the strip to the wall if required. These can be passed through the apertures 18 in the direction of the arrow 20 illustrated in Figure 1. There are three horizontal rows of apertures provided if the strip 1 requires cutting in half horizontally along incision 19, to be used in reduced spaces, there will be a line of apertures available for each half of the strip which remains. To obtain a vertical positioning guide, strip 1 is placed vertically aligned to line 9 at right angles to the horizontal positioning guide strip 1 aligned to line 10, Figure 12, enabling vertical alignment of the tiles 13 to the edge of the flat surface 6. The line 9 is drawn at a point where the extremity of the last full tile can be applied in proximity to the fixed furniture 24 Figure 12 or in the proximity for example of a re-entrant corner 15, Figure 12, where a vertical positioning guide strip 1 aligned to a line 7 positions the last full vertical tile course 25, before the corner is reached.

Tiles 13 can now be adhered to the wall, resting on the horizontally fixed tile support 1 aligned to line 10, Figure 12, and against the vertically positioned tile support 1 aligned to the vertical lines 9 and 7 illustrated in Figure 12 when the areas of tiling are completed and the tile adhesive 16 Figure 1, is set, the remaining irregular spaces can then be filled with tiles cut to fit.

Conventionally the positions of tiles on a wall as known to those skilled in the art, is that courses of tiles applied at the lowest point on a wall are full sized tiles. Also tiles along a wall Figure 12 are fixed so that a full tiles width is centred laterally between the walls extremities and that the vertical tile courses remaining, which are less than one tiles width are distributed equally to the extremities of the wall 17. A vertical course of tiles the same width as the vertical course 17 appearing on the left hand extremity of the wall illustrated in Figure 12 would also be affixed to the right hand extremity of the wall (Not shown).

If thicker wall tiles are being affixed the strip 1 Figure 10 can be

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adhered to another strip to increase the horizontal thickness providing increased support for the tiles.

The version of the strip illustrated in Figure 14 is applied as required, in the same way as other versions of the strip and is the basic version of the "Self adhesive tile support strip." If however tiles without integral spacing lugs or bevels are used, tile spacers are placed between the tile and horizontally applied tile strips flat support surface 6, to achieve the necessary horizontal space between the first and second course of tiles.

The version of the strip illustrated in Figure 15 is applied as required, in the same way as other versions of the strip. The strip differs from the version with 'V' shaped vertical incisions 21 Figure 2 in that the incisions made into this version of the strip are vertical square shaped incisions 27 and extend vertically down the face of the strip from one support surface to the other. These incisions made at any frequency width or depth into the front face of the strip, provide the strip with its flexibility so that it may be used on uneven or curved surfaces.

The version of the strip illustrated in Figure 16 is applied as required, in the same way as other versions of the strip. The strip differs from the version with 'V's shaped 21 or square sided 27 vertical incisions in that the incisions are made into the front and rear face of the strip in the same way as the previous version and can be 'V' shaped or square sided. This version achieves the greatest degree of flexibility of versions using vertical incisions. The rear incisions permit concave flexibility, the front incisions permit convex flexibility. This version achieves the greatest flexibility of all versions of the strip using vertical incisions. To differentiate between incisions made into the front face and rear face of the strip, vertical square sided rear incisions are numbered 33 and vertical 'V' shaped rear incisions are numbered 34 (not shown).

The version of the strip 35, illustrated in Figures 17 and 18 is applied as required in the same way as other versions of the strip. The strip differs from other versions in that spaces 30 between the support sections of the strip 28 are used to achieve flexibility in conjunction with a flexible backing strip 29 to which they are attached instead of using the vertical incisions 21, 27, 33 or 34 to achieve flexibility. The flexible backing strip 29 follows the profile of the raised support surfaces 4 and the lower alignment surfaces 8 of the support sections 28 with its raised support surfaces 31 and lower alignment surfaces 32 which permit the alignment of the strip to horizontal 10 and vertical lines 9 Figure 12 drawn on the surface to be tiled, in the same way as other versions of the tile support strip with raised support surfaces interspersed with lower alignment surfaces. Two different support surfaces are provided, raised support surfaces as before are used when tiles without spacing lugs or bevels are being applied. The flat support surface 6 is to be found on the underside of the strip Figure 17, it is used as before, when tiles with spacing means, bevels or lugs are incorporated on tiles being adhered.

The strip 1 for supporting, squaring, positioning and spacing wall and

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floor tiles can be used to tile a floor surface as mentioned earlier. The task of tiling a floor 22 is undertaken by placing the strip 1 of length "D,C" at right angles to a dotted line "A,B" set between the door jambs "X,2" and extending towards the opposite wall. Similarly a strip 1 "D,G" is placed at right angles to the strip "D,C" whose inside edge 6 indicates the last full tile width along the room. The self adhesive backing strip 2 can be used to attach the strip to the floor 22 or the apertures 18 in Figure 4 can be used to attach the strip to the floor 22 with nails. The tiles are fixed beginning in the top left hand corner where the strips 1 meet to form a right angle. When the tile adhesive is dry and the strips 1 have been removed, the irregular spaces left around the room can be filled with tiles cut to fit.

If thicker floor tiles are being laid the strip 1 Figure 11 can be adhered to another to increase the depth vertically providing a deeper squaring and positioning guide.

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CLAIMS:

1. A strip for supporting, squaring, guiding and/or spacing wall or floor tiles on flat, curved or uneven surfaces, said strip being substantially rigid in a transverse direction so as to support a course of tiles thereon but sufficiently flexible in a direction perpendicular to the plane of the strip to allow the strip to be shaped against an uneven or curved base surface.
2. A strip as claimed in claim 1 wherein said strip has a self-adhesive backing.
3. A strip as claimed in claim 1 wherein said strip has plurality of apertures capable of receiving nails or tacks.
4. A strip as claimed in any one of claims 1 to 3 wherein said strip has at least one indentation in at least one face thereof to facilitate flexing of the strip.
5. A strip as claimed in claim 4 wherein there is a series of indentations at spaced locations along the length of the strip on at least one face thereof.
6. A strip as claimed in claim 4 or claim 5 wherein the indentations comprise a series of transverse grooves at spaced intervals along the length of the strip.
7. A strip as claimed in claim 6 wherein the grooves are generally parallel to one another and generally perpendicular to the edges of the strip.
8. A strip as claimed in claim 6 or claim 7 wherein said strip has grooves in both the front and rear faces with the grooves in the front and rear faces being staggered in relation to one another.

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9. A strip as claimed in any one of the preceding claims wherein said strip has at least one longitudinal groove in at least one face to facilitate cutting of the strip.
10. A strip as claimed in any one of claims 6 to 9 wherein the grooves are in the form of generally V-shaped slots.
11. A strip as claimed in any one of the preceding claims wherein said strip has a spaced series of outwardly projecting lugs along one edge of the strip to facilitate the positioning of tiles without integral spacers.
12. A strip as claimed in any one of the preceding claims wherein said strip is fabricated in natural material or a plastics material or a combination of both.
13. A method of tiling including applying a strip as claimed in any one of the preceding claims, against a wall or floor surface to provide a guide for the positioning of a series of tiles.
14. A strip for supporting, squaring, guiding and/or spacing wall or floor tiles on flat, curved or uneven surfaces, substantially as herein before described with reference to and as shown in the accompanying drawings.
15. A method of tiling substantially as hereinbefore described with reference to the accompanying drawings.

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Patents Act 1977
Examiner's report to the Comptroller under
Section 17 (The Search Report)

Application number

9125902.8

Relevant Technical fields

(i) UK CI (Edition K) E1S (SAB, SAD): E1D (DPG)

(ii) Int CL (Edition 5) E04F: E04G

Search Examiner

A H MITCHELL

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASE: WPI

Date of Search

10 JUNE 1992

Documents considered relevant following a search in respect of claims

1-15

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2231067 A (BRUCE)	1, 3, 4
X	GB 2093495 A (BOBS) note the cuts 4a, 4b	1, 3, 1
X	US 4942670 (BRANDT) example of adhesive backed template	2
A	US 4583343 (CAMP)	1

- 14 -

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

D: Document indicating lack of novelty or of inventive step.

D1: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

-1/6-

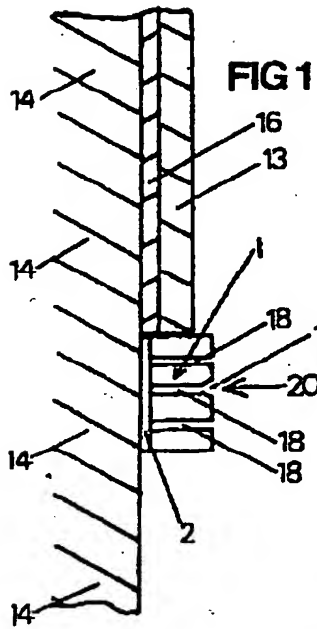


FIG 1

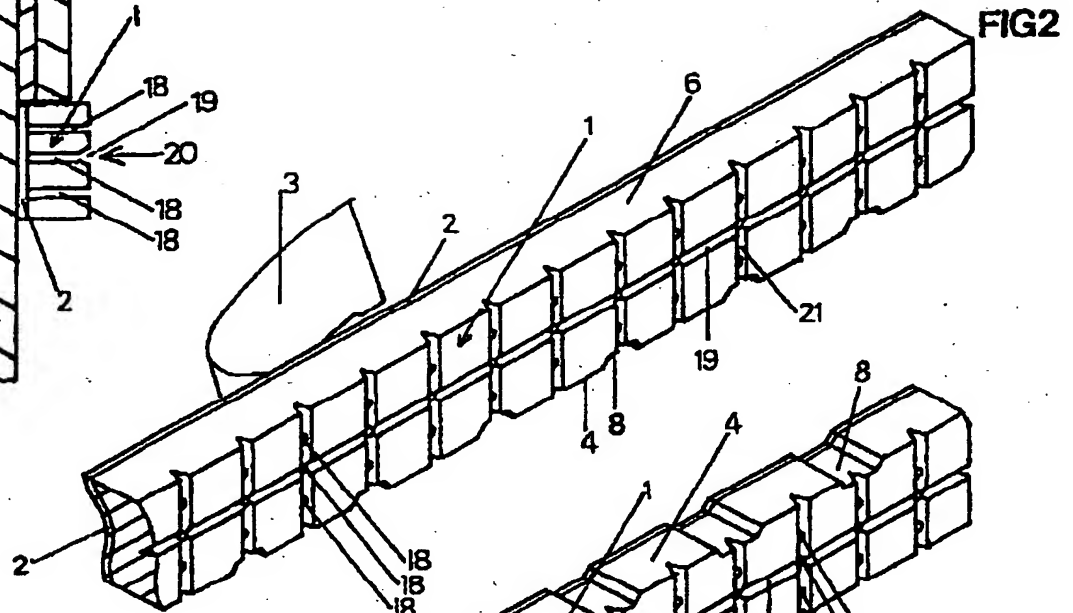


FIG 2

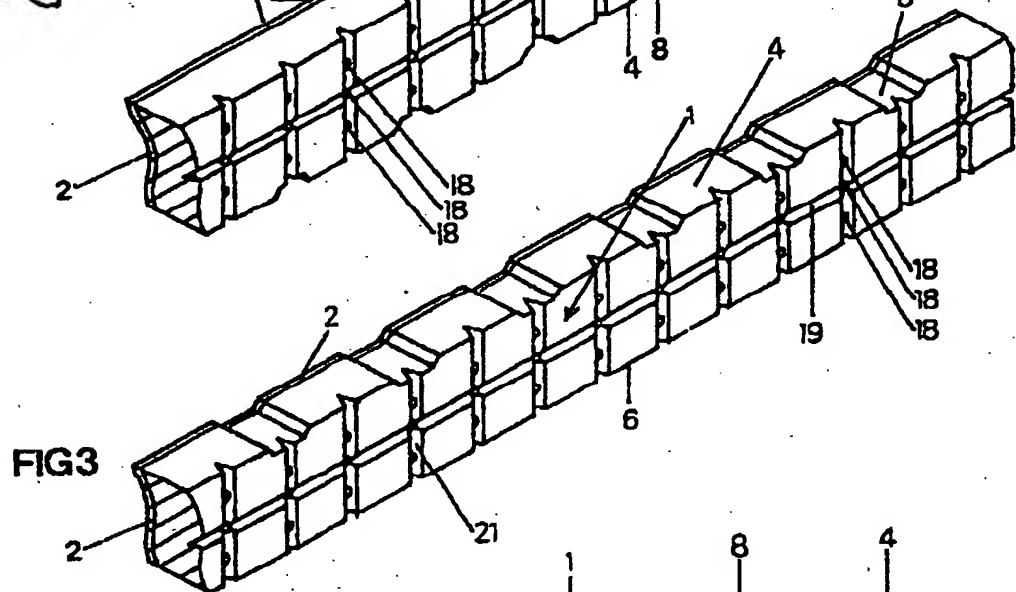


FIG 3

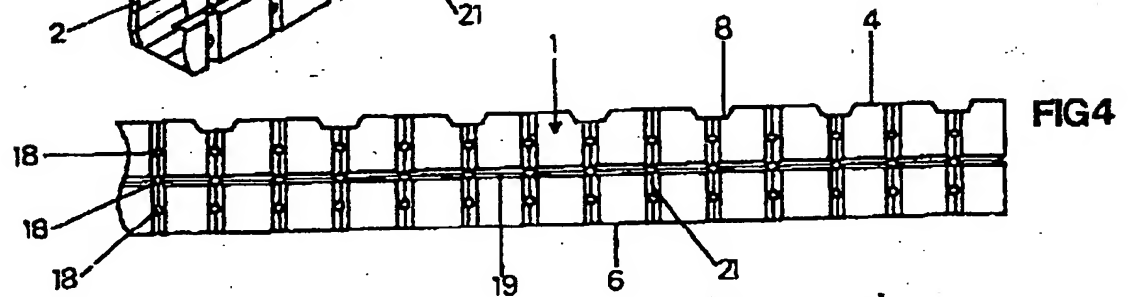


FIG 4

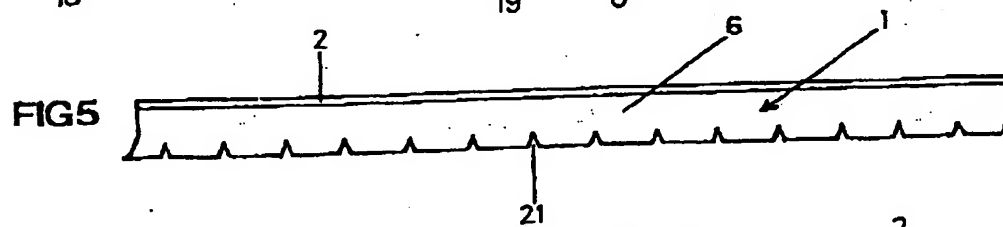


FIG 5

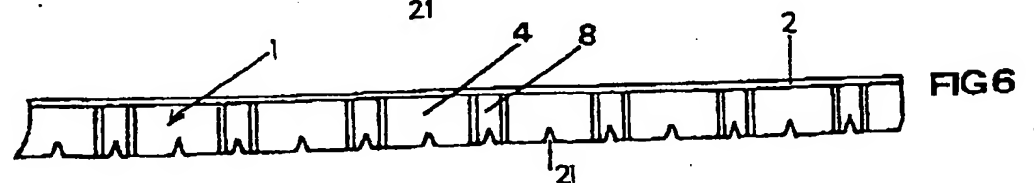
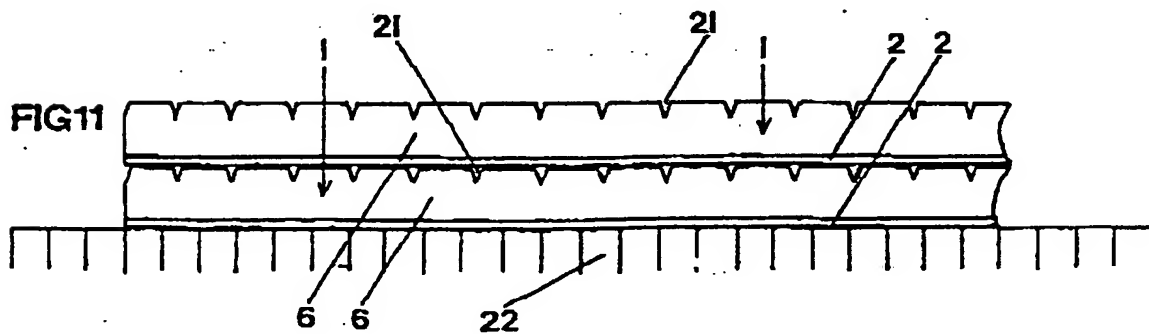
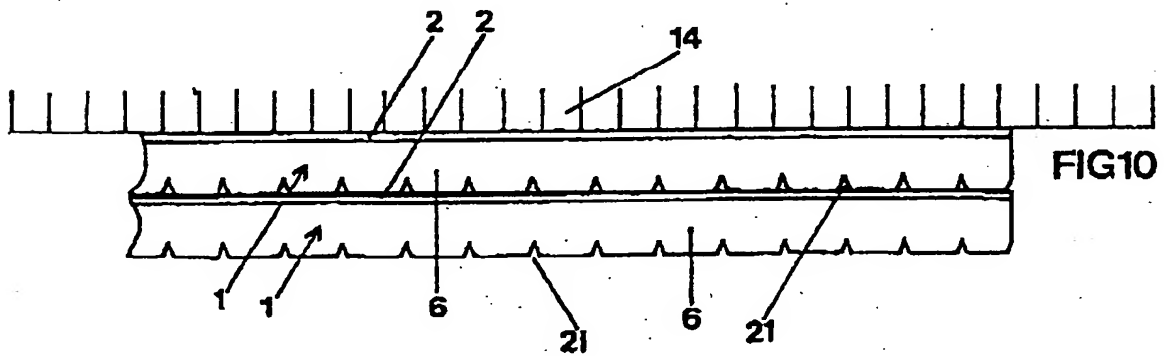
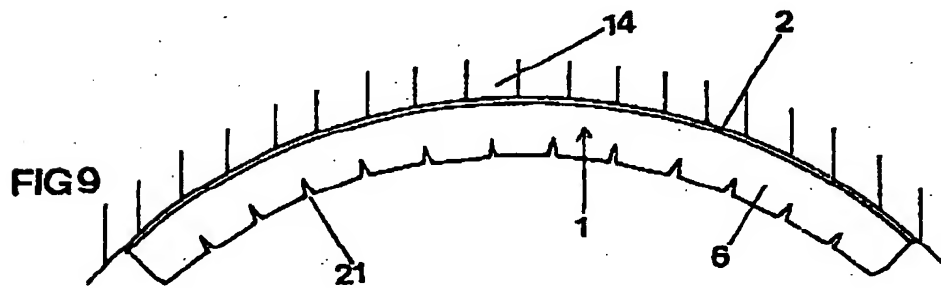
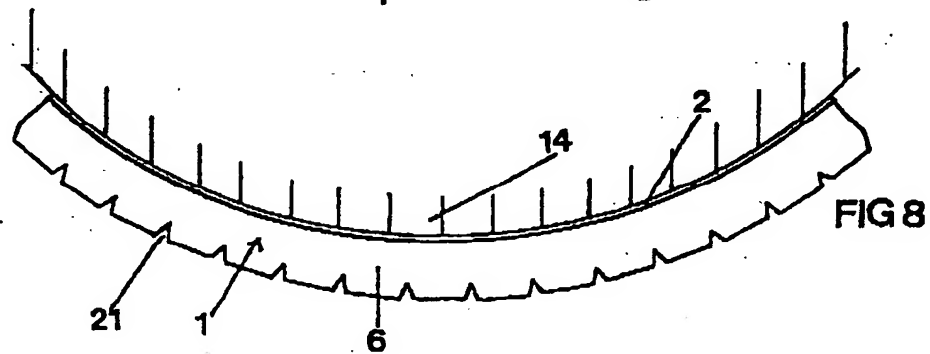
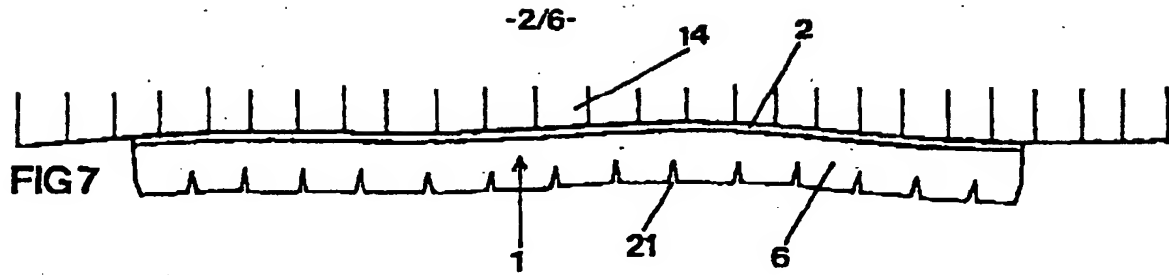
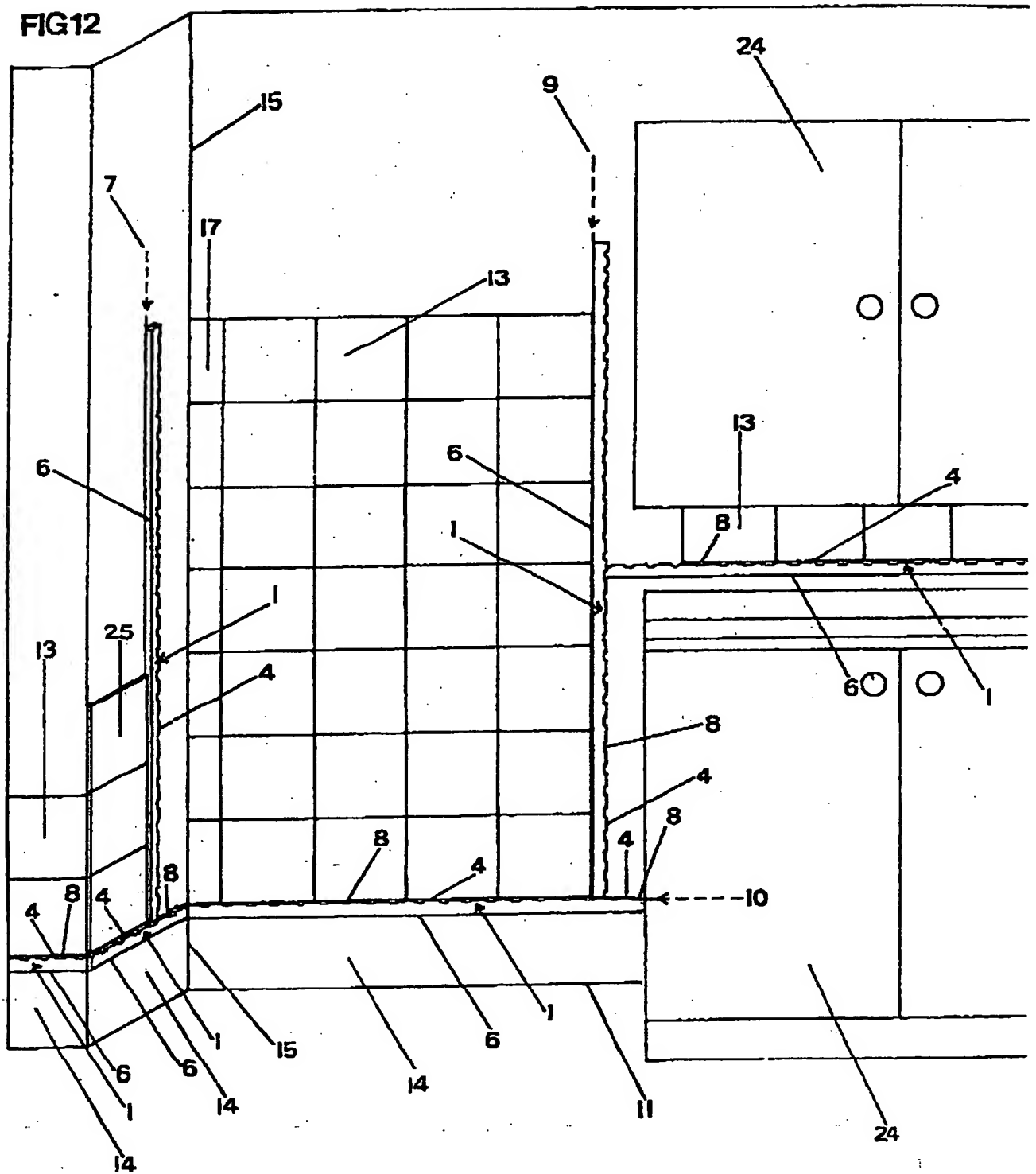


FIG 6

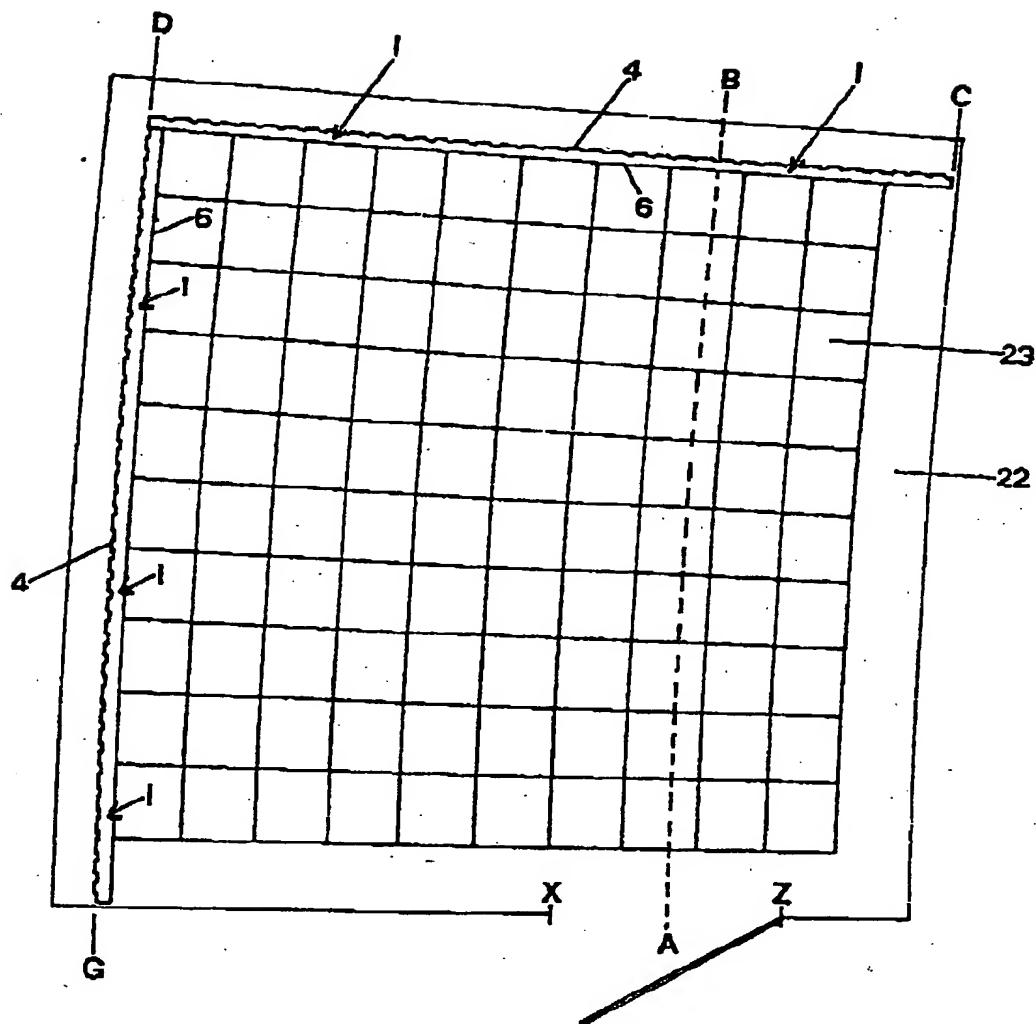


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FIG13



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FIG 17

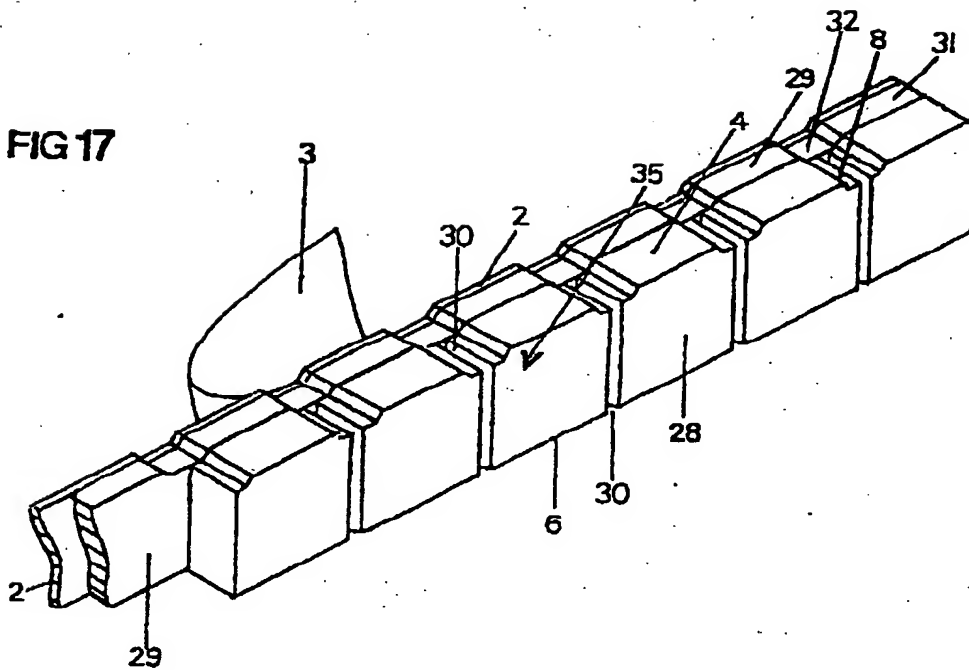


FIG18

